STUDIES IN FRUIT DISEASES

II

DISEASES OF PLUMS AND THEIR CONTROL

IMPERIAL [illegible]
18 MAY 1931
INSTIT

BY

G. H. BERKELEY, M.A., Ph.D.

SENIOR PATHOLOGIST-IN-CHARGE*
DOMINION LABORATORY OF PLANT PATHOLOGY
ST. CATHARINES, ONT.

DIVISION OF BOTANY
DOMINION EXPERIMENTAL FARMS

H. T. GÜSSOW
DOMINION BOTANIST

DOMINION OF CANADA
DEPARTMENT OF AGRICULTURE
PAMPHLET No. 119—NEW SERIES

Published by Direction of the Hon. W. R. Motherwell, Minister of Agriculture, Ottawa, 1930

TABLE OF CONTENTS

	Page
Black knot	3
Brown rot	5
Plum pockets	7
Shot hole or leaf spot	8
Silver leaf	9
Winter injury	9
Spray schedule for plums	11
Standard spray materials and disinfectants	12

DISEASES OF PLUMS AND THEIR CONTROL

By G. H. BERKELEY, M.A., PhD.,

Dominion Laboratory of Plant Pathology, St. Catharines, Ontario *

Plums, like other tree fruits, are subject to various diseases which, under favourable conditions, may cause considerable damage to crops. In the following pages, the symptoms and control measures of some of the more common diseases of plums are described. To obtain satisfactory control of these diseases a grower should follow carefully the control measures outlined. Half measures, here, as elsewhere, will not give satisfactory results. The grower should realize that control measures to-day are based not only on scientific knowledge of the fungi causing disease, but also on practical tests in commercial orchards. The recommendations herein given are therefore the best obtainable to-day. To obtain good results in controlling plum diseases, practise the sanitary and cultural measures recommended as well as the spray schedule. Both are essential to good control. In other words, plant diseases can be controlled but they must be fought squarely, by marshalling against their attack all the control measures known to-day to be of value in checking their spread.

BLACK KNOT. (***Dibotryon morbosum*** **(Schw.) Theiss. & Syd)**

This is not only the most common and conspicuous disease of wild and cultivated plums in Canada, but as well, is perhaps the most destructive. It also attacks the cherry, but is by no means as severe on the cherry as it is on the plum. In neglected orchards this disease will, in a very short time, so adversely affect and devitalize the trees that the orchard becomes useless. The distinctive symptom of this disease, as its name implies, is the black knot or gall formed

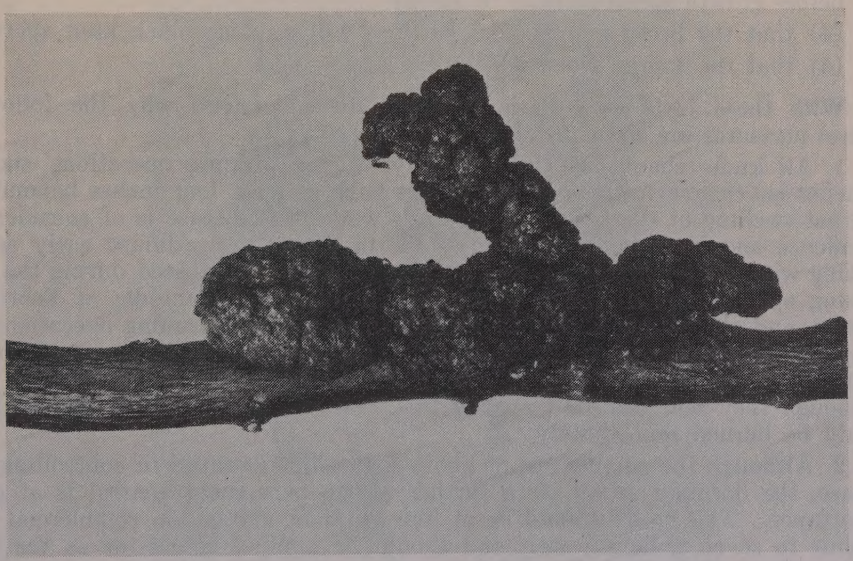

Fig. 1. Black knot on plum

* Pamphlet No. 119, Revision of circular No. 15, by H. R. McLarty.

9131—1½

on the woody parts of the tree. These knots, though mainly found on the twigs and smaller branches, may, however, be found on the trunks of large trees. The knots are first found as swellings in the late fall, or, more commonly in the early spring after growth starts. As growth continues the swellings crack open and a yellowish-brown granular growth fills the crevices. As the season develops further the swelling increases and the irregular knot-like growth becomes more pronounced. Shortly after the granular growth in the crevices appears, the surface of the knot is covered with a light green, velvet-like pile. On this surface are the summer spores of the fungus. Towards fall the knot becomes darker and goes into the winter condition perfectly black. In the following spring, the black knot gives rise to another spore form which initiates the disease the following spring. In other words, with this disease, spores are being given off during the summer, till towards fall, and again early the following spring, so that infection may take place over a long period of time. When the spores light on a tender branch and find conditions favourable to germination and growth, infection may take place. When the infection has once gained an entrance into the plum tree it develops and grows, until finally a black knot results. It should also be realized that not only are new knots developed from the spores from old, mature knots, but as well, the old knots themselves continue to grow and enlarge in size and diameter, until in some cases they become over a foot in length. Of course, some of these extra large ones are really the final result of two or more growing together thus forming one.

Control

It should be clearly understood that control measures are based upon the following facts in the life cycle of the fungus responsible for " black knot."

(1) that the fungus is perennial in diseased branches and extends beyond the limits of the knots.

(2) that conidia—the summer spores of the fungus—are mature and ready for infection when the knot shows a velvety olive green pile.

(3) that ascospores—the early spring spores—mature early in the spring just before growth starts.

(4) that the brush-pile of knot cuttings will produce black knot spores.

(5) that the spores are wind-borne.

With these facts as a basis it is readily understood why the following control measures are recommended.

1. All knots should be cut out early, during pruning operations and all branches bearing such knots should be cut back at least four inches beyond the external swelling of the knot. In orchards where this disease is of considerable prevalence and importance, it is advisable to follow the ordinary early spring pruning with a later inspection and pruning of any knots missed during the first pruning operations. All knots should be cut out by the middle of February, at least, and all cuttings should be burned as soon as the pruning operations are complete. Experience has demonstrated that, if the prunings are left on the ground for any considerable length of time, the knots will sporulate just as though they had been left on the tree. So all diseased twigs and cuttings should be burned immediately.

2. Although the cutting out of knots is the first essential in controlling this disease, the dormant spray, as a further aid to permanent control is of great importance. This spray should be of lime sulphur, one gallon commercial lime sulphur to seven gallons water, and should be applied before, or as the buds are bursting. It is also advisable to make additional applications of summer strength lime sulphur (one gallon commercial lime sulphur to 40 gallons water) just before blossoming and just after petals fall.

3. It is also well to remember that the spores of this disease are carried by the wind and that therefore if there are any wild plums, or cultivated but neglected orchards in the vicinity of your orchard, it is only to be expected that your problem will be considerably more difficult due to the constant infections coming from such neglected trees. It is therefore advisable to cut and destroy all wild plum trees from the vicinity of your plum orchard. In districts where this disease is very severe, it will be necessary for a community effort to be undertaken in order to control the disease. Because if a district as a whole is severely infected with black knot, it is extremely difficult for an individual grower to keep his orchard clean while nearby orchards are allowed to remain diseased.

BROWN ROT. (***Sclerotinia americana*** **(Worm.) Nort. & Ezek.)**

Brown rot is a disease which attacks all stone fruits, that is cherries, peaches and plums. It attacks the blossoms, causing a blossom blight; the twigs, causing a twig blight; the branches, causing cankers; and the fruit, causing a rot. It makes its first appearance each year at blossoming time, in the form of the so-called blossom blight. Blossom blight is very prevalent in those seasons, when humid, wet conditions prevail previous to, or during the blossom period. After the blossom period, the disease, as a rule, does not manifest itself until the fruit nears maturity, when small brown spots may be notice-

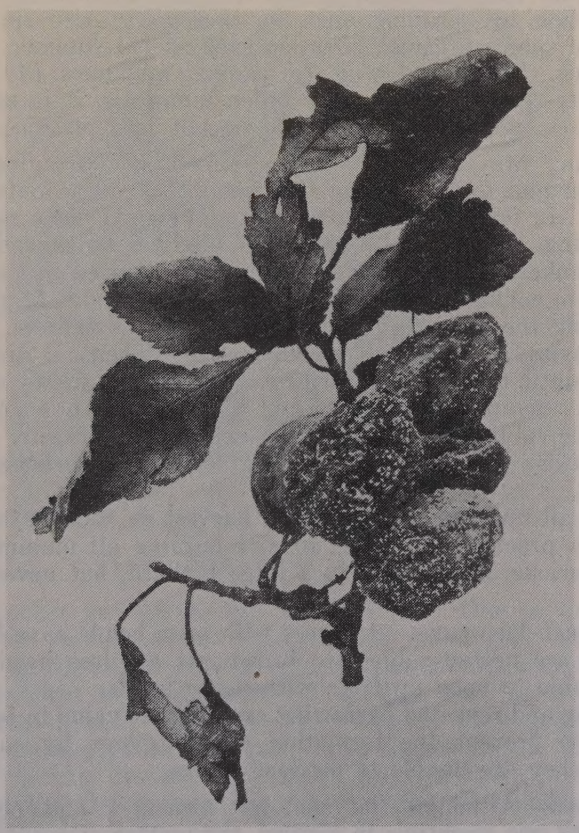

Fig. 2. Brown rot on plum

able on the skin of the fruit. As the disease progresses, these spots enlarge, become soft, and give rise to the common brown rot which is so noticeable on stone fruits. In a few days the whole fruit is involved and grayish tufts appear on the surface of the fruit. These tufts are the spores or seeds of the fungus and are carried by the wind to near-by fruit. Often these diseased fruits dry up, hang on the tree, and form the so-called " mummy " that is so common and conspicuous during the winter time, on plum trees that were badly infected with brown rot during the previous season. Mummies which hang on the tree give rise to spores the following spring. The mummies which fall to the ground give rise in the following spring to a different type of spore, the so-called ascospore, which is dispersed at about the time the plums come into blossom. It has been shown, however, that if a mummy is covered by two inches of soil, it is not likely to sporulate the following spring and this fact is made good use of from the standpoint of control and is the basis for the recommendation that all plum orchards should be ploughed in the spring in order to bury any mummies that may be lying on the ground, partially covered. Of perhaps equal importance is constant harrowing, disking, etc., early in the spring, previous to the blossom period in order to so disturb the mummies near the surface of the ground that their chances of sporulating are greatly decreased.

Control

Experience has demonstrated that brown rot is by no means an easy disease to control. Since all parts of the tree may be attacked at one time or another, protection by spraying must be thorough. Also since there are so many sources of spores to cause infection such as (1) summer spores from (*a*) blighted blossoms, (*b*) blighted twigs, (*c*) hanging mummies, (*d*) cankers and (2) ascospores (early spring spores) from fallen mummies, it is essential that the sanitary measures as given below should be put into practice.

(*a*) Sanitary Measures.—These are aimed at destroying the source of spore production and thus lessening the amount of spore material which may cause infection. In this way, less spore material should mean simplified control.

1. In pruning, remove and destroy all blighted twigs and cankers where possible. All cankers on small branches may be removed in their entirety, but in the case where cankers are so situated that they cannot be removed without seriously injuring the tree, they should be treated as follows. Clean out the canker by removing all gum and foreign matter. Then cut around the outline of the canker until the exposed surface is clean and shows no signs of discoloured tissue. Scrape the wood clean. Disinfect with a good disinfectant, such as corrosive sublimate and after the exposed and freshly cut surface has been allowed to dry out, paint over the surface with a carbolineum compound, or whitewash it.

2. Destroy all mummied fruit during harvest or shortly thereafter. Some growers make a practice of raking up and burning all mummied fruit. This is quite a labourious undertaking in a large orchard, but nevertheless is to be recommended.

(*b*) Cultural Practices.—1. Trees with open heads have better air drainage, and hence are not so subject to brown rot as close headed trees. It is therefore advisable to open up trees with dense heads.

2. Ploughing and repeated harrowing are of great value in brown rot control as they tend to prevent the formation of ascospores by so disturbing the mummies that they are unable to produce spores.

(*c*) Spraying.—Although the sanitary measures and cultural practices already described are essentials in control, the matter of spraying is the prime essential and should be a regular yearly practice. The first spray should be

applied just before bloom; the second when the shucks are shedding; the third about two weeks later and the fourth application should be applied about three weeks before picking. Lime sulphur 1 to 40 is the fungicide most generally used on plums.

PLUM POCKETS. (*Taphrina Pruni* (Fuck.) Tul.)

While this disease does not, as a rule, do very great damage in Canada, there are cases on record where the losses have been quite severe. In Nova Scotia it is sometimes severe, especially on Japanese varieties; frequent cases have been reported where trees have shed their entire set of fruit. It is the fruit which is chiefly affected, but young branches and leaves may also be attacked. The disease makes its first appearance in the spring soon after the petals fall when infected fruit becomes a pale yellow, to red colour. Later the surface becomes covered with a grayish powder, the spores of the fungus, and the fruit becomes hollow. In the final stage the fruit becomes black, hard and brittle.

Fig. 3. Plum pockets (after Laubert)

Tender branches and leaves are also affected. Due to the action of the fungus they often become much distorted and small gray masses of spores, similar to those on the fruit, occur on affected parts. Diseased branches should be especially watched for and destroyed, as they play an important part in the spread of the disease. This trouble is caused by a fungus very closely related to that causing peach leaf curl. The fungus spends the winter in the dormant stage in the diseased branches. As the warm weather of spring approaches, activity and growth are renewed and the fungus penetrates the young ovary of the developing fruit, causing the swelling and marked distortion spoken of above.

Control

In Nova Scotia it has been found that a dormant spray, followed by a spray before the blossoms open, gives excellent results in controlling this disease.* The dormant spray should be applied in the early spring, and preferably just before the buds start to swell. The dormant spray is essential in Nova Scotia for the control of this disease.

SHOT HOLE OR LEAF SPOT. (*Coccomyces prunophorae*) Higg.

Shot hole, leaf spot, or yellow leaf, as it is sometimes called, is a very common disease on plums and cherries. In some seasons this disease is very severe, the *Cylindrosporium* stage of the fungus causing partial to almost complete defoliation. When the disease is so severe that partial or complete defoliation takes place, the trees produce no crop to speak of, and are considerably weakened for the following year. If, by any chance, the intervening

Fig. 4. "Shot hole" on plum leaves

winter is an unusually severe one such weakened trees are more subject to injury than they otherwise would be. This disease is manifest mainly on the leaves, although the fruit, fruit pedicels and leaf pedicels may also be affected. Early in June, or later, affected leaves show slightly discoloured, dark blue areas on the surface. These later become reddish brown in colour and as the disease progresses the leaf often turns yellow. The term "shot hole" has originated because of the fact that a large percentage of these diseased areas drop out, leaving holes in the leaf.

The term "yellow leaf" has been derived from the fact that in a good many cases infected leaves with spots, or sometimes without, become quite yellow. As stated above, when the infection is severe, partial or almost complete defoliation may result.

* Schedule recommended by Mr. J. F. Hockey, Plant Pathologist, Kentville, Nova Scotia.

The fungus lives over the winter on diseased leaves that fall to the ground. In the spring a new crop of spores is produced, which initiates the disease. During the summer, spores are produced on the infected leaves.

Control

Control is based on the destruction of old leaves and the protection of new leaves during the growing season. In practice, this is generally accomplished by spraying with lime sulphur, summer strength; the first application being given when the petals have practically all fallen; the second application follows in two weeks time, and the third, two weeks later. It is also advisable to have the over-wintered leaves ploughed under by cultivation previous to period of bloom.

SILVER LEAF. (*Stereum purpureum* Fr.)

In Canada, this disease is very widely distributed, being known from Vancouver Island to Nova Scotia. Although it is perhaps best known here on the apple, it is primarily a disease of plums. In England, it has become a very serious menace to this fruit and recently, very drastic legislation has been enacted to prevent its further spread.

The external signs of the disease are confined to the leaves. In the beginning, the trouble is usually confined to one branch, the leaves developing an unmistakable silvery or leaden sheen. This appearance is due to the formation of air spaces beneath the skin of the leaf, due to a splitting of the tissues in the interior of the leaf. Other branches become affected, some of the leaves often showing brown streaks and stains. Affected branches begin to die back or sometimes, the entire branch dies suddenly. At this stage, the whole tree often becomes affected, all the leaves appearing silvered and death soon follows. The fruiting stage of the fungus later appears on the dead wood. There appear purplish crusts crowded together in irregular rows and it is from these that the spores are produced. The latter, being borne about by the wind, cause new infections, provided an entrance can be obtained through a wound.

Although a great deal of research has been carried out, no reliable cure has been found. The only means of control therefore, is to take stringent measures against its spread. In slightly affected trees, cut off the branch affected below the point where the last brown stain appears in the wood; paint over the cut; and burn the pruned limb. Dead or dying trees should be completely uprooted and destroyed.

WINTER INJURY

Winter injury of plum trees may take any one of several different forms such as (1) Dieback of twigs; (2) Killing of blossom buds; (3) Root killing; (4) Crown injury; (5) Frost browning; and (6) Sunscald.

(1) Dieback.—Trees which, for some reason or another go into the dormant state with immature wood, may fall a prey to dieback, that is killing back of the twigs. Such twigs generally become attacked by weak parasitic fungi such as Cytospora, Valsa, Nectria, etc.

(2) Blossom Buds.—Buds may be killed by unusually low temperature during normal dormancy, or as is more general, by early December freezes while the buds are not sufficiently hardened, or by later freezes following unseasonable warm weather which starts the buds into activity.

(3) Root and Crown Injury.—This type of injury is quite common with the plum. The term root injury refers to injury of the roots, whereas crown injury refers to the injury at, or near the surface of the ground, often involving the roots near the surface as well.

(4) Frost Browning.—Severe frost often has the effect of turning the entire heart wood of a tree a dark brown to black colour. Whether or not this condition adversely affects the tree depends upon its severity. In many cases the tree does not seem to be injured to any appreciable extent. On the other hand, trees that have been killed outright during the dormant period often show this decided browning.

(5) Sunscald.—This type of injury is quite common and often severe. It is found on the limbs and trunk and on the south or southwest side of the tree. The trouble is apparently caused by severe frost following bright, warm sunshine.

Cause

All the above forms of winter injury are not necessarily due to cold alone. Plant tissue under normal conditions is able to withstand very low temperatures. However when trees go into the dormant period with tissues immature, they are apt to be affected with some form of winter injury. The grower should therefore endeavour to keep his trees from growing too rapidly or too late. The following factors may be mentioned as some of the more important causes contributing to winter injury.

1. Wet feet, or too much water in the soil, due to lack of drainage or excessive rainfall, or both. Tile under-drainage is, of course, strongly recommended to overcome poor drainage.
2. Late cultivation which tends to force late growth and hence produce immature tissue.
3. Warm continued weather in late fall, or at any time during the dormant period, may start or continue growth resulting in immature wood.
4. Severe pruning which is apt to stimulate late growth.
5. Low vitality of the tree. This may be caused by many factors such as impoverished soil, incorrect cultivation, partial or complete defoliation by fungi or insects and any other factor or factors which produce abnormal growth conditions.
6. Late applications of growth producing fertilizers.

Prevention and Treatment

(*a*) Prevention.—The following suggestions may be of value in this connection:—

1. The soil should be well drained. The orchard should have good natural drainage. If not, then a system of under-drainage is to be recommended.
2. In choosing the site of a new orchard, keep uppermost in mind the matter of soil and air drainage. Orchards in low-lying, insufficiently drained land will not do well.
3. Avoid late cultivation.
4. Be sure that plenty of plant food is present in the soil. If not, add humus by way of manure or cover crops. The addition of nitrogenous fertilizers is often to be recommended.
5. Cover crops are also of advantage in hardening up the wood in that they tend to stop late growth.
6. Prevent defoliation by insects or fungi by strictly adhering to spray schedule recommended.
7. Avoid severe summer pruning.

(*b*) Treatment.—In the case of sunscald and collar rot especially, treatment is often advisable. If a rot has started, cut away the diseased tissue until healthy tissue is exposed. Disinfect with corrosive sublimate and leave the wound exposed to the sun's rays for a week or so at least. Then paint with coal tar or carbolineum compound.

Where the rot completely girdles the trunk, bridge-grafting may be advisable.

Where limbs are sunscalded, or twigs killed, it is advisable to cut them out as soon as possible, provided the branches are not skeleton branches, which, if removed, would spoil the tree. If such limbs near the trunk are rotted, they should be treated as described above.

SPRAY SCHEDULE FOR PLUMS

The following spray schedule, accompanied by good sanitary and cultural practices as recommended, should give satisfactory commercial control of the foregoing diseases.

1. Dormant Spray.—To be applied early in the spring before, or as the buds are bursting. Use lime sulphur, one gallon of commercial lime sulphur to seven gallons water (sp. gr. 1·035). This application is to insure a general cleanup of all spores on the tree, but particularly for black knot, and plum pockets. It also takes care of scale, red mite, etc. If insects are not a factor, a 1 to 40 (sp. gr. 1·007-1·008) mixture will be strong enough.

2. Pre-Blossom Spray.—To be applied just before the blossoms open. Use lime sulphur, one gallon of commercial lime sulphur to 40 gallons water (sp. gr. 1·007-1·008). This application, although particularly aimed at blossom blight control, is of equal value in controlling plum pockets, black knot and leaf spot.

3. Shucks Spray.—To be applied as soon as most of the shucks are off. Use lime sulphur, one gallon to 40 gallons water. It is advisable to add 1½ pounds of arsenate of lead or one pound of arsenate of lime to the lime sulphur for this application to control curculio and other insects.

First Summer Spray.—Same material as shucks spray above. To be applied about 12 days later.

Additional Sprays.—In wet seasons additional applications may be necessary at two or three week intervals, particularly on varieties subject to rot. An application of lime sulphur 1 to 50, wettable sulphur, or sulphur dust (without poison) about 10 days before picking should be given to all varieties subject to rot. This checks "rotting" of mature fruit and improves shipping qualities.

Note No. 1.—On Japanese varieties, use lime sulphur 1 to 50 in place of the 1 to 40 strength after the trees have leafed out.

Note No. 2.—If preferred, Bordeaux mixture may be used in place of lime sulphur. Lime sulphur is in more general use on plums, however.

Caution.—Spraying to be of any value must be thorough. Apply plenty of spray so that all parts of the trees are covered with the spray material. Use a fine mist, with pressure around 250 pounds. Be sure and reach the top of the tree as well as the tips of all branches.

ADDITIONAL CONTROL MEASURES

In addition to the spraying schedule as outlined above, the following auxiliary measures should be adopted:

1. Cut out and burn all black knots, cankers, blighted twigs and diseased branches. Be sure to have all knots, cankers, etc., removed and burned before growth starts in the spring.

2. Destroy all mummied fruit left hanging on the tree after harvest. These should also be burned before growth starts in the spring.

The practice of ploughing and harrowing just previous to blossoming is an aid in brown rot and leaf spot control, because if mummies and leaves are buried deep in the ground they are not so apt to sporulate.

STANDARD SPRAY MATERIALS AND DISINFECTANTS

Commercial Lime Sulphur.—This is readily obtainable on the market from various supply houses. It comes in two forms, liquid and dry, both of which have given good results. The liquid is in more general use, however.

Bordeaux Mixture.—This spray material is prepared from copper sulphate (bluestone), lime and water, and the common formulae now in use is:—

Copper sulphate	3 pounds
Hydrated or fresh stone lime	6 pounds
Water	40 gallons.

Hydrated lime is much the more convenient form to use as it does not require slaking, but it must be fresh, because if left exposed to the air it will become useless. It should be kept in a dry place.

Bordeaux is generally made in the tank as follows: Partially fill the tank with water, add powdered bluestone, or the bluestone may be dissolved previously and added in liquid form. Then start the engine to agitate the mixture. Add the lime and agitate for five minutes. As with the bluestone, the lime may be dissolved previously and then added to the mixture in the spray tank.

Wettable Sulphur (dry mix).—This is a commercial product. Follow the directions on the package.

Corrosive Sublimate.—This is a mercuric poison used as disinfectant in canker treatment. This is generally obtained in tablet or powder form. The standard strength used is 1 to 1000. A tablet in a pint of water, or 2 ounces of the powder in 15 gallons water gives this strength.

STUDIES IN FRUIT DISEASES

I. Tomato Diseases—by G. H. Berkeley (Bulletin No. 51—New Series Revised Edition).

II. Diseases of Plums and their Control—by G. H. Berkeley (Pamphlet No. 119).

Ottawa: Printed by F. A. Acland, Printer to the King's Most Excellent Majesty, 1930.